

WHAT IS CLAIMED IS:

1 1. A polymer electrolyte membrane comprising a quaternized
2 amine salt on a support matrix.

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4 2. The polymer electrolyte membrane of claim 1, further
5 comprising a fuel cell comprising an anode and a cathode,
6 wherein said fuel cell is a liquid-feed fuel cell and wherein
7 the polymer electrolyte membrane is disposed between the anode
8 and cathode.

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10 3. The polymer electrolyte membrane of claim 2, wherein said
11 fuel cell is a direct methanol fuel cell.

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13 4. The polymer electrolyte membrane of claim 1, wherein the
14 quaternized amine salt is selected from the group consisting
15 of a poly-4-vinylpyridinebisulfate, a poly-4-
16 vinylpyridinebisulfate silica composite, and a combination
17 thereof.

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19 5. The polymer electrolyte membrane of claim 1, wherein the
20 support matrix is selected from the group consisting of a
21 glass fiber matrix, a polybenzoxazole matrix, and a
22 polybenzimidazole matrix.

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24 6. A methanol fuel cell comprising:
25 an anode;
26 a cathode;
27 a proton-conducting membrane comprising a quaternized amine
28 salt on a support matrix; and
29 a pump element, in fluid communication with the anode.

31 7. The fuel cell of claim 6, wherein the fuel cell uses
32 methanol.

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34 8. The fuel cell of claim 6, which is a direct methanol fuel
35 cell.

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37 9. The fuel cell of claim 6, wherein the quaternized amine
38 salt is selected from the group consisting of a poly-4-
39 vinylpyridinebisulfate, a poly-4-vinylpyridinebisulfate silica
40 composite, and a combination thereof.

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42 10. The fuel cell of claim 6, wherein the support matrix is
43 selected from the group consisting of a glass fiber matrix, a
44 polybenzoxazole matrix, and a polybenzimidazole matrix.

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46 11. A proton conducting membrane comprising a quaternized
47 polyvinylpyridine polymer or composite.

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49 12. The proton conducting membrane of claim 11, wherein the
50 composite comprises a nanoparticulate oxide.

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52 13. The proton conducting membrane of claim 12, wherein the
53 composite is a poly-4-vinylpyridine bisulfate silica.

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55 14. The proton conducting membrane of claim 11, wherein the
56 quaternized polyvinylpyridine is poly-4-vinylpyridine
57 bisulfate.

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59 15. A method of forming a proton conducting membrane
60 comprising
61 dissolving poly-4-vinylpyridine in a solvent to form a
62 mixture;

63 contacting the mixture with sulfuric acid or phosphoric
64 acid to obtain a precipitate;
65 recovering the precipitate;
66 mixing the precipitate with an aqueous solvent to form a
67 paste; and
68 applying the paste to a support matrix.

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70 16. The method of claim 15, wherein the solvent is methanol.

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72 17. The method of claim 15, wherein the precipitate is a
73 poly-4-vinylpyridine bisulfate.

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75 18. The method of claim 15, wherein the aqueous solvent is
76 water.

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78 19. The method of claim 15, wherein the support matrix is
79 slected from the group consisting of a glass fiber matrix, a
80 polybenzoxazole matrix, and a polybenzimidazole matrix.

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82 20. The method of claim 15, further comprising adding
83 nanoparticle silica to the mixture prior to adding the acid.

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85 21. The method of claim 20, wherein the precipitate is a
86 poly-4-vinylpyridine bisulfate silica.

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88 22. The method of claim 20, wherein the silica is rich in
89 surface hydroxyl groups.